AUTOMATED PIN FOR GAS ASSISTED INJECTION MOLDING SYSTEM

Background of the Invention

Gas assisted injection molding of plastic has long been known in the industry. During gas assisted injection molding molten plastic is forced into an enclosed mold, and gas is injected into the mold within the plastic material. The gas will raise the internal mold pressure and create an expanding gas pocket which will force the cooling plastic to the extreme recesses of the mold, yielding a better fill-out of the mold surface and reducing the sag of the plastic from the mold surface as the plastic shrinks during cooling, thus producing a better finish surface.

There are two main methods of injecting gas into the mold cavity, the first is directly injecting the gas into the mold cavity, known as in article, the second is injecting the gas into a channel leading into the mold, which is known as in-runner. The injection of the gas remotely into the cavity is generally preferred over the channel method.

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Nozzles for use in-article or in-runner remote gas injection devices are subjected to packing by the molten plastic injected into the mold. Such gas injection nozzles are typically located near the plastic injection nozzle so that the gas injected can best assist the flow of the plastic material throughout its flow through the mold. This however typically subjects the gas injection nozzles to the flow of molten plastic at its most liquid state and highest pressure, which tends to clog or pack air injection nozzles. Further, gas injection nozzles are typically used as gas exhaust outlets, so that any molten material will tend to flow toward and into the outlet during the venting process. Cycle time of the molding process is critical to production cost, so venting before the interior of the part has completely cooled may be desirable, creating the potential condition for uncooled material flow toward the gas nozzle. To inhibit the flow of molten resin into the gas nozzle, two approaches have typically been used: a valved fluid nozzle (i.e. U.S. Patent No. 5,232,711), or to use an injection pin with very small orifices which tend to resist the flow of the molten resin (i.e. U.S. Patent No. 5,820,889). Another method employed to avoid the clogging of the gas supply passages with molten resin is to delay gas injection until the plastic injection is completed, as described in U.S. Patent No. 5,295,800. However, this allows the plastic to cool somewhat, which reduces the flowability of the material, and reduces the efficacy and efficiency of the gas injection process.

The use of valved gas nozzles adds complexity and expense to the entire system. Injection molding is a relatively high production process, so such nozzles are subjected to repeated exposure to molten resin under pressure, which inevitably leads to the intrusion of resin into the inlet. A valved nozzle requires a reciprocating motion opposing the intrusion of plastic or overcoming the gas injection pressure, a motion that requires a relatively large force which may lead to wear and failure. Since repairing or replacing such reciprocating nozzles or valves is time consuming and expensive in material cost and in down time, it is necessary to have a heavy duty but simple device. Examples of prior art reciprocating nozzles or pins are shown in U.S. Patent Nos. 4,740,150; 4,905,901; 5,151,278; 5,164,200; 5,198,238 and 5,464,342.

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Description of Preferred Embodiment

The present invention is a gas injection nozzle pin assembly for a gas assisted plastic injection molding system as shown in the attached Figure 1. The assembly 10 generally comprises a nozzle having a gas inlet port which communicates with a stored gas which is used to control the metering and flow of the gas into the nozzle. The nozzle includes a generally cylindrical body member 12. Extending from the body member on one end thereof is a pin member 14 containing an elongated cylindrical bore 16. The cylindrical bore has a conical nozzle end 18 which is used to mate with and accept an automatically controlled rod 20. The rod extends along the entire length of the cylindrical bore and into the body member of the nozzle assembly. The rod includes a frustoconical shape 22 on its end such that it mates with the conical nozzle end 18 of the cylindrical bore 16 to create a specific outlet size for gas escaping into the interior of the mold assembly.

The rod is controlled by the use of an electromagnetic solenoid 24 or other type of electronic actuator which will use electrical power to control movement of the rod in and out of the conical nozzle end, based on a sequence of events occurring in the molding operation. The electronic actuator is located within the body of the nozzle assembly and is securely connected to one end of the rod. The electronic actuator is controlled via an electronic control assembly which is attached to the control unit for the gas assisted injection molding assembly. The electronic actuator is activated by introducing current through an electromagnetic coil which is attracted to magnetically conductive metal at an end of the body 12. Additional electromagnetic inserts are preferably located at each end of the body 12 to increase the magnetic attractive forces, and to increase the return force when deactivated. It is preferred to have the device magnetically biased toward the closed position. A coil spring can also be utilized to bias the mechanism toward the closed position.

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An alternate embodiment, not shown, includes a pneumatically controlled actuator for reciprocating the rod. Still another embodiment includes a ball screw drive for driving the rod, which is provided with a threaded end.

The use of the electronically controlled rod will allow the operation of the valve at precise intervals during the plastic injection in the mold such that flow-back does not occur within the